Zero Retries issue 0089 2023-03-10

Zero Retries is an independent newsletter about technological innovation in Amateur Radio. Zero Retries promotes Amateur Radio as (literally) a license to experiment with radio technology.

About Zero Retries

Steve Stroh N8GNJ, Editor

Jack Stroh, Late Night Assistant Editor Emeritus

In this issue:

- **Request To Send - Three Audiences for Zero Retries**
- **hz.tools - Radio Technology From a Software Perspective**
- **NPR-VSAT - New High-Speed Data Mode**
- **ZR > BEACON**
- **Updata**
- **Feedback Loop**
- **Join the *Fun* on Amateur Radio**
- **Closing The Channel**

Request To Send

Boilerplate
I've been asked why Zero Retries includes "so much boilerplate" information such as **Join the Fun on Amateur Radio** and **Closing the Channel**.

Answer: I write Zero Retries with this reader in mind:

- Younger; of the generation that's grown up with pocket supercomputers and ubiquitous Internet connectivity, typically via wireless ("phones");
- Has a technical background or at least curious about technology;
- Curious about radio technology and perhaps some exposure to radio technology other than Amateur Radio, such as using Family Radio Service (FRS) units, Wi-Fi, Bluetooth, LoRa, etc.
- Little or no prior exposure to Amateur Radio or newly licensed but not much idea what to do next;
- Mostly interested in data modes via radio;
- Cannot find the kind of information that I try to bring forth in Zero Retries in other mediums;
- Enjoys information presented as text. 😀

In short... I (try to) write Zero Retries partly for my 15-year-old self, growing up technically curious, especially about all things radio technology, in a town that didn't offer much in the way of technical stimulation. One of my formative memories about Amateur Radio was finding a cache of donated 73 Magazine issues at Ida Rupp Public Library. I read those few issues obsessively to learn about the *cool* stuff in Amateur Radio, such as Radio Teletype (RTTY) (data communications over radio!). I *learned so much* just from reading those magazines because they gave me pointers to things that I had no idea existed!

But I also write Zero Retries for a second audience - the fiercely smart, technically proficient students in college engineering programs that don't have any previous exposure to Amateur Radio… that need a stimulating project to work on. I "encountered" this audience repeatedly during the two years I was a member of ARDC's Grants Advisory Committee. ARDC would often receive grant proposals from students (and professors…) that essentially wanted to reinvent an existing technology or simply weren't aware of actual "interesting problems" in radio technology. The authors of such grant proposals (and their advisors) apparently weren't aware of the staggering amount of technological innovation *that is occurring* in Amateur Radio that they could "tap into" and build upon instead of trying to reinvent existing technology or "solve" non-existent problems. My hope for Zero Retries to help this audience is that when they do their background research, they'll find "pointers" (at a minimum) to potential research topics in Zero Retries.

With those audiences in mind, I try to write Zero Retries so that it's not just useful in the moment… but also useful if "found later". I try to provide sufficient information *in every issue* for a new reader to "find their way forward" - to obtain their Amateur Radio license (and inspiration for why they would want to), see something of the amazing range of technological innovation that's happening in Amateur Radio, *and that they can participate in*.

There's a third audience that I target, subtly, for Zero Retries - personnel in regulatory agencies such as the US Federal Communications Commission (FCC).

I know that it's controversial to discuss the potential for loss of Amateur Radio spectrum. (Cue eye rolling and skipping to the next article). Potential spectrum loss *is a real issue that is confronting Amateur Radio*, especially Amateur Radio in the US, whether we like it, *or not*, and whether we're prepared for it, *or not*, and whether we protest it, *or not*.

Presenting a Reasonable Case for Amateur Radio Spectrum
Amateur Radio, and especially Amateur Radio in the US, needs to be able to "present a reasonable case" for maintaining the use of spectrum that is allocated to it. Before space constraints dictated that the quotes that appeared in every issue of Zero Retries were pushed to a separate About page, this quote was included:

Ultimately, amateur radio must prove that it is useful for society.
Dr. Karl Meinzer DJ4ZC.

Yep. ***That!*** From one of the most respected Amateur Radio Operators of our era.

Permit me to offer an analogy[1].

> I used to live in a semi-rural area near a river valley where commercial development was prohibited. The valley was mostly reserved for "agricultural and recreational" use. A group of remote control (R/C) airplane hobbyists had used one of the many fields in the valley for a long time. The R/C'ers kept the field well-maintained. They kept it mowed, kept an eye on it to prevent "incompatible uses" (no camping, etc.), and generally maintained good relations with "SoccerOrg" which actually owned the field. The R/C organization kept the R/C'ers organized and enforced appropriate rules such as no R/C flying on days when the soccer fields nearby were in use, "just in case" an RC plane were to go out of control. In short, the R/C'ers were ideal "tenants".
>
> One day, with no warning, a new sign appeared in the area near the R/C'ers signboard used for listing R/C frequencies in use. The sign said that R/C activities were no longer permitted because the field was about to become a soccer field.
>
> Of course, the R/C'ers protested at the abrupt change in status of "their" field. Essentially their argument was "We were good stewards of the field! We didn't do anything wrong! You said we could use the field for R/C activities!".
>
> The succinct answer from "SoccerOrg":
> *Yes, the R/C'ers were great stewards of our vacant field, and they didn't do anything wrong. "SoccerOrg" allowed R/C'ers use the vacant field as long as "SoccerOrg" didn't need it as a soccer field. Now "SoccerOrg" requires more soccer fields, so please vacate the field as instructed.*[2]

In my observations, that's a reasonable analogy for the historical use of spectrum by Amateur Radio activities - a long history, but "tenant" status.

US Amateur Radio may or may not be given advance notice of the next big spectrum reallocation. Given that the FCC has required "process" that it must follow, hopefully, such an action won't be a *fait accompli* (as was the case with the US Amateur Radio 3.5 GHz bands). If Amateur Radio is to have any chance at "making its case" for maintaining spectrum, it has to be a *strong case with objective justification* why Amateur Radio is a net benefit to society and retain use of valuable spectrum.

For example, given that Starlink terminals are now essentially portable and can provide Broadband Internet nearly anywhere, Iridium "Next" satellite phones can provide reliable voice service nearly anywhere, and FirstNET provides "hardened" cellular infrastructure with (enforced and monitored) priority to public safety users… the case for Amateur Radio as emergency communications isn't nearly as persuasive as it was a decade ago.

However, one credible argument that *can* be made to support the continued allocation of spectrum to Amateur Radio is *technological innovation in radio technology*. But, you won't find much[3] evidence of technological innovation in the pages of QST, which is essentially the "publication of record" for US Amateur Radio.

Thus, if… *when*… it comes time to provide documented evidence of Amateur Radio's utility in radio technology experimentation, development, and practical usage, the 90+ issues of Zero Retries (and continuing), and a conference paper - or two, *can* provide such documented evidence of Amateur Radio's contribution to technological innovation of radio technology.

I have some experience with "providing documented evidence…" to the FCC. In my former career, I was asked to provide testimony to an FCC Task Force. Doing so was an… *interesting*… experience! Fortunately, I knew my subject matter well and (in my opinion) I gave a reasonably compelling presentation. There were a lot of very good questions asked, and the "competition" that also testified to the task force was well-prepared to exploit any weaknesses in my presentation. The primary lesson I took away from that experience is "be prepared… *very well prepared*… long in advance."

It is a reasonable observation that 90+ issues of Zero Retries is a bit much to wade through to find some choice nuggets that illustrate technological innovation in radio technology… *point taken*! Thus it's a project of mine for 2023-1H to develop two presentations (slide decks):

- Amateur Radio audience - Explain Zero Retries and highlight five significant projects in Amateur Radio that demonstrate technological innovation specific to Amateur Radio.
- Regulatory agency or other non-Amateur Radio audience - Minimally technical, highlighting *unique* contributions within Amateur Radio of technological innovation in radio technology.

Those… and a few other Zero Retries projects and a major personal project, will make 2023 a busy year for me.

de Steve N8GNJ

Leave a comment

Share

---

hz.tools - Radio Technology From a Software Perspective

By Steve Stroh N8GNJ

I first mentioned the work of Paul Tagliamonte K3XEC in Zero Retries 0024 - Intro to PACKRAT Tutorial Series. I said:

> *I've only made time to casually browse this series, but it really does look understandable for a typical techie. Something like this has been needed for a long time - how you go from software defined radio to data modulation / demodulation. With some focused study, I think even I could get this. Kudos K3XEC!*

In the intervening fourteen months, K3XEC has been busy fleshing out his vision for a well-documented, understandable "single perspective" Software Defined Radio protocol stack. hz.tools is a teaching tool, and as with his PACKRAT Tutorial Series, K3XEC is "paying it forward" by helping to make Software Defined Radio technology more understandable.

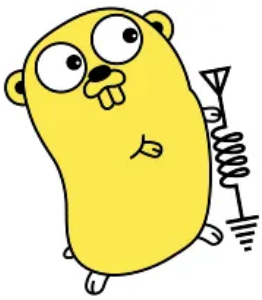

Image courtesy of Paul Tagliamonte K3XEC

> Announcing hz.tools
> Paul Tagliamonte 2023-02-22
>
> Ever since 2019, I've been learning about how radios work, and trying to learn about using them "the hard way" – by writing as much of the stack as is practical (for some value of practical) myself. I wrote my first "Hello World" in 2018, which was a simple FM radio player, which used librtlsdr to read in an IQ stream, did some filtering, and played the real valued audio stream via pulseaudio. Over 4 years this has slowly grown through persistence, lots of questions to too many friends to thank (although I will try), and the eternal patience of my wife hearing about radios nonstop – for years – into a number of Go repos that can do quite a bit, and support a handful of radios.
>
> …
>
> **Intention behind hz.tools**
>
> It's my sincere hope that my repos help to make Software Defined Radio (SDR) code a bit easier to understand, and serves as an understandable framework to learn with. It's a large codebase, but one that is possible to sit down and understand because, well, it was written by a single person. Frankly, I'm also not productive enough in my free time in the middle of the night and on weekends and holidays to create a codebase that's too large to understand, I hope!
>
> I remain wary of this project turning into work, so my goal is to be very upfront about my boundaries, and the limits of what classes of contributions i'm interested in seeing.
>
> Here's some goals of open sourcing these repos:
>
> - I do want this library to be used to learn with. Please go through it all and use it to learn about radios and how software can control them!
> - I am interested in bugs if there's a problem you discover. Such bugs are likely a great chance for me to fix something I've misunderstood or typoed.

- I am interested in PRs fixing bugs you find. I may need a bit of a back and forth to fully understand the problem if I do not understand the bug and fix yet. I hope you may have some grace if it's taking a long time.

…

Should you use [hz.tools]?

Probably not. The intent here is not to provide a general purpose Go SDR framework for everyone to build on, although I am keenly aware it looks and feels like it, since that what it is to me. This is a learning project, so for any use beyond joining me in learning should use something like GNU Radio or a similar framework that has a community behind it.

In fact, I suspect most contributors ought to be contributing to GNU Radio, and not this project. If I can encourage people to do so,contribute to GNU Radio! Nothing makes me happier than seeing GNU Radio continue to be the go-to, and well supported. Consider donating to GNU Radio!

Github repo of hz.tools

While I concur with K3XEC's endorsement of GNU Radio as the "go-to" for Software Defined Radio work, hz.tools is a significant contribution, "alongside" GNU Radio.

Kudos again, K3XEC, for your great contribution!

Leave a comment

Share

NPR-VSAT - New High-Speed Data Mode

By Steve Stroh N8GNJ

In 2019, Guillaume F4HDK unveiled New Packet Radio (NPR), a clean-sheet-of-paper4 approach to high(er) speed data communications over Amateur Radio. NPR operates at 500 kbps, using a 100 kHz channel in the Amateur Radio 420-450 MHz band using a "reasonable to reproduce" set of hardware modules. Notably, F4HDK didn't just create new hardware for NPR; he designed NPR's modulation, NPR's protocol, implemented a repeater mode, etc.

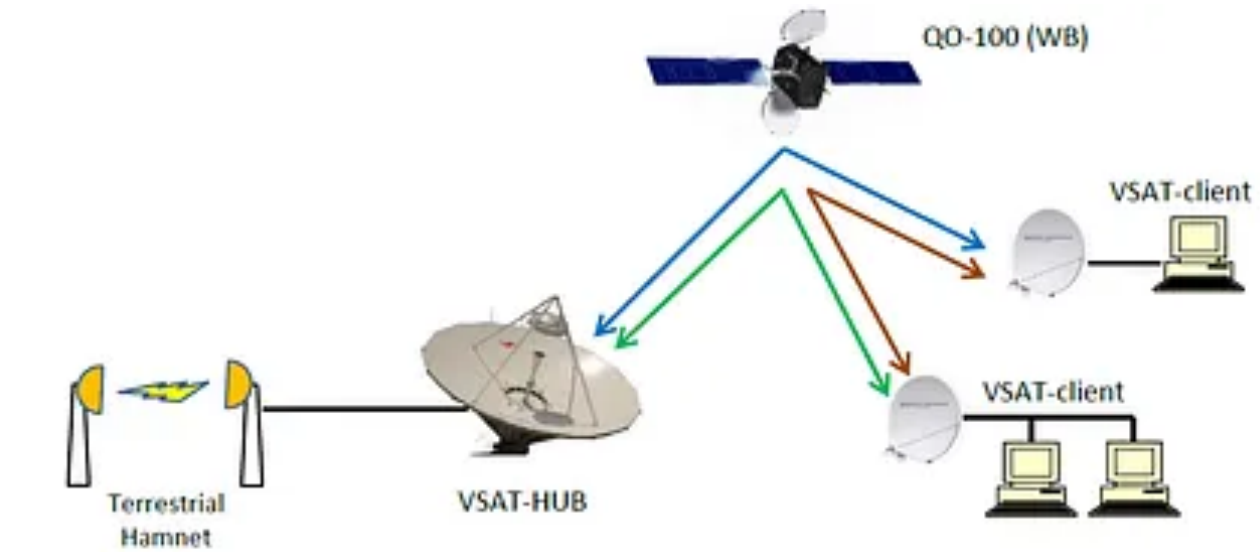

Image courtesy of Guillaume F4HDK

NPR-VSAT is a new system by F4HDK, based on NPR. VSAT is an acronym for Very Small Aperture [Satellite Ground Station] Terminal. In my opinion, calling it **NPR-QO-100** would be more easily understood as this new system is designed specifically for QO-100's Wideband digital transponder.

F4HDK developed NPR-VSAT to enable IPv4 (Internet Protocol - TCP/IP) networking between Amateur Radio Operators via the QO-100 Geosynchronous Earth Orbit (GEO) satellite payload's Wideband Transponder at high(er) speeds - 200 kbps, with an effective throughput of ~100 kbps. As with NPR, NPR-VSAT is an open source project, and designed specifically for Amateur Radio use on Amateur Radio spectrum. Thus NPR-VSAT conforms to various constraints required for Amateur Radio, notably regular transmission of Amateur Radio Operator callsigns, and (explicitly) no encryption.

NPR-VSAT requires a station called the VSAT-HUB to be online continuously on QO-100's Wideband digital transponder. VSAT-HUB acts

as a “traffic cop” for NPR-VSAT users by coordinating these functions:

- Informs the members about the network characteristics (channels, their frequency, their symbol rate, timing characteristics, IPv4 configuration and routing),
- [Provides] a central clock / timing, in order to synchronize the network,
- Allocates RF resources (channels and timeslots) among clients, dynamically, depending on their needs, in real-time,
- Manages the connection and disconnection of members (clients) to the network,
- Manages the allocation of IPv4 addresses,
- Interconnects the IPv4 subnet [of NPR-VSAT users on QO-100] with [HAMNET].

QO-100’s Wideband digital transponder is 8 MHz wide, full duplex, with uplink on 2.4 GHz and downlink on 10 GHz:

- 2401.500 - 2409.500 MHz Uplink
- 10491.000 - 10499.000 MHz Downlink

As with NPR, F4HDK did an amazing amount of work to conceptualize, implement, and test this new system, and he documented it well:

- NPR –VSAT (Hamnet / IPv4 over QO-100) User guide Version 0.4 (PDF - 19 pages)
- NPR - VSAT - New Packet Radio - VSAT Protocol Specification Version 0.2 (PDF - 21 pages)

NPR-VSAT uses a combination of software running on a (“robust”) host computer (Windows or Linux) and a Software Defined Transceiver:

- LimeSDR Mini (now the LimeSDR Mini 2.0)
- Analog Devices ADALM-PLUTO
- (Soon) All SDR hardware that is compatible with Soapy SDR.

In addition to the Software Defined Transceiver, other radio hardware is required to transmit and receive effectively to / from QO-100 in geosynchronous orbit (22,300 miles above the equator). Such equipment includes a 2.4 GHz power amplifier, likely a 10 GHz receive preamplifier, dish antennas, high quality coaxial cable, etc.

Because the VSAT-HUB station has to operate continuously to enable this new mode, and it’s a brand new mode, the managers of QO-100 are… cautious.

F4HDK:

- The current version is usable for beta-tests.
- In parallel, I am under discussion with AMSAT-DL [manager of QO-100].
- At short term, we are allowed to make short duration tests (~30 min maxi).
- It is currently too early to say if we could have one day a permanent 24h/day unattended NPR-VSAT Hub station. I dream of it, it would be the ultimate achievement.
- It depends also on the interest and acceptance of the "community".

Peter DB2OS responded:

> To get a broader agreement and acceptance we will establish an “expert team” to review and investigate [Technical Feasibility and Coordination and band planning].

This is *exactly* the kind of Zero Retries Interesting experimentation I had imagined from the availability of a GEO payload such as QO-100. I’ll guess that it’s also a welcome development that helps justify what must have been a considerable investment in development and hardware to include the Wideband digital transponder on QO-100.

I hope that there will be an equivalent GEO payload accessible to the Western Hemisphere - see *GEO! GEO!! GEO!!!* in Zero Retries 0077.

But beyond NPR-VSAT’s design for QO-100, two ideas come to mind:

- QO-100’s Wideband digital transponder is 8 MHz wide (actually 16 MHz wide - 8 MHz uplink and 8 MHz downlink). Thus it’s feasible that (depending on the complexity of QO-100’s hardware) to implement create a Wideband digital transponder (based on QO-100’s) on a mountain or very high tower. Instead of using 2.4 GHz / 10 GHz as uplink and downlink frequencies, for terrestrial use, use an 8 MHz channel within the 1240-1300 MHz band for the uplink, and an 8 MHz channel within the Amateur Radio 420-450 MHz band for the downlink.

- NPR-VSAT is one of the few implementations of high-speed data on a Software Defined Transceiver. Most other software for Software Defined Transceivers merely emulate a conventional (hardware) transceiver… with a few better features than a hardware transceiver.

My thanks to Jeff Davis KE9V for the pointer to this development.

Leave a comment

Share

ZR > BEACON

- **Applied Etherics** (Let's learn about radio electronics!) is a newsletter by Jason Milldrum NT7S to develop (and explain) "Project Yamhill".
  I am envisioning a modular system that consists of a 3D printed open chassis / backplane with integrated PSU and a user interface panel, with spaces for standardized-sized PCB modules and spaces to route signal cables. The main product would be a high-performance QRP CW transceiver, but the platform could also be reconfigured for different RF projects and experiments such as a simple receiver for those without a ham license, a SSB rig, or a WSPR platform, to name a few off the top of my head. Circuits would be focused around the block diagram of the transceiver, so that each PCB corresponds to a block. Most components would be pre-populated SMT, so that the end user would installing things like toroids and connectors that require human construction.
  After you read the first few articles, you'll quickly get NT7S' concept for Project Yamhill. I was impressed that he's developing the substrate as a project that can be 3D printed.

- **FreeDV aims to bring open-source HF digital voice into the mainstream**
  This Amateur Radio Digital Communications (ARDC) grant is notable not just for the amount ($420,000) but because of the achievement record of two principals of this grant - David Rowe VK5DGR and Mooneer Salam K6AQ.

Updata

- My two CaribouLite RPi HAT units from Crowd Supply have finally arrived. Now to dig out some Raspberry Pi units to host them.

- This week I shipped my *15th* box of Amateur Radio printed media to the Internet Archive's digitizing center destined for the Digital Library of Amateur Radio & Communications. This batch includes some very rare Amateur Radio newsletters that as far as I can tell, are completely unique; some of them I can't even find a *mention of* online.

Feedback Loop

Comments:

- **ReadyKillowatt** re: Zero Retries 0088 - *Here's a DC-1.8GHz front end for a software defined radio transceiver. Just add 10Gbps Ethernet, and back end server - https://www.harmonicinc.com/broadband/pebble-2-device/*

If you provide feedback via email, I may excerpt your feedback or include it in full. Unless you specifically grant me permission to include your name, I won't do so. Feedback may be lightly edited for clarity.

Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, check out
Join the Fun on Amateur Radio for some pointers.

Zero Retries Frequently Asked Questions (FAQs) - In development 2023-02.

Closing the Channel

In its mission to highlight technological innovation in Amateur Radio, promote Amateur Radio to techies as a literal license to experiment with wireless technology, and make Amateur Radio more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to anyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex, which hides Amateur Radio content behind paywalls.

My ongoing ***Thanks*** to:

- Tina Stroh KD7WSF for, well, *everything!*

- **Pseudostaffers** Dan Romanchik KB6NU and Jeff Davis KE9V for continuing to spot, and write about "Zero Retries Interesting" items on their blogs that I don't spot on my own.

- **Newsletters** that regularly feature Zero Retries Interesting content:
    - Amateur Radio Weekly by Cale Mooth K4HCK is a weekly anthology of links to interesting Amateur Radio stories.
    - Experimental Radio News by Bennet Z. Kobb AK4AV discusses (in detail) Experimental (Part 5) licenses issued by the US FCC.
- **YouTube channels** that regularly feature Zero Retries Interesting content:
    - HB9BLA Wireless by Andreas Spiess HB9BLA
    - KM6LYW Radio by Craig Lamparter KM6LY emphasizes Amateur Radio data communications such as the DigiPi project.
    - Tech Minds by Matthew Miller M0DQW is subtitled Ham Radio - SDR - RF Projects - Software - Tutorials.
- The Substack email publishing platform makes Zero Retries possible. I recommend it for publishing newsletters.

If you're reading this issue on the web and you'd like to see Zero Retries in your email Inbox every Friday afternoon, just click below to join ~~100~~ ~~200~~ ~~300~~ ~~400~~ *500* ~~600~~ *700+* other readers:

Subscribe now

Please tell your friends and co-conspirators about Zero Retries - just click:

Share Zero Retries

Offering **feedback or comments** for Zero Retries is equally easy - just click:

Leave a comment

If you're a fellow smart person that uses **RSS**, there *is* an **RSS feed for Zero Retries**.

Zero Retries (N8GNJ) is on Mastodon - n8gnj@mastodon.radio - just click:

Zero Retries / N8GNJ on Mastodon

Email issues of Zero Retries are "instrumented" by Substack to gather basic statistics about opens, clicking links, etc.

More bits from Steve Stroh N8GNJ:

- SuperPacket blog - *Discussing new generations of Amateur Radio Data Communications - beyond Packet Radio (a precursor to Zero Retries)*
- N8GNJ blog - *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs - Bellingham, Washington, USA*

Thanks for reading!
Steve Stroh N8GNJ / WRPS598 (He / Him / His)
These bits were handcrafted (by a mere human, not an Artificial Intelligence bot) in beautiful Bellingham (The City of Subdued Excitement), Washington, USA.

2023-03-10

If you'd like to reuse an article in this issue, for example for club or other newsletters, just ask. Please provide credit for the content to me and any other authors.

All excerpts from other authors or organizations, including images, are intended to be fair use.

Portions Copyright © 2021, 2022, and 2023 by Steven K. Stroh.

Blanket permission granted for TAPR to use any Steve Stroh content for the TAPR Packet Status Register (PSR) newsletter (I *owe* them from *way* back).

1

This is all from 30+ year old memory; I have no sources to cite, so if I got details on this wrong, please forgive my fallible memory.

2

Postscript (again, from 30+ year old fallible memory) - The R/C'ers eventually found another big vacant field that they could use, but the new location was in a *very* rural area, like a 45 minute drive from the previous R/C field. One R/C'er I talked to said "It was never the same, very few people actually used the new field."

3

While QST does document *some* technological innovation… it doesn't do *much*, or *often*. For example, Eclectic Technology, a monthly one-page column that highlighted technological innovation in Amateur Radio, was discontinued in 2022. ARRL promotes its newsletter QEX for "technical" articles, but (in my personal perspective), most QEX content is academic in nature. Not to mention that ARRL publications are accessible only to the ~20% (and falling) of US Amateur Radio Operators that are dues-paying ARRL members.

4

Emphasis on ***New***, rather than *Packet Radio*; the author uses "Packet Radio" in a functional sense as in "Packets send over Radio", not classic "Packet Radio" based on AX.25.